

Applications

Adequate nutrient management requires a good understanding of the orchard local conditions, soil type, irrigation systems, tree demand and nutrient supply or availability. Many factors should be considered when developing a nutrient management plan for the orchard. See [Tree Fruit Soil Fertility and Plant Nutrition in Cropping Orchards in Central Washington](http://treefruit.wsu.edu) <treefruit.wsu.edu> for details about how to create a fertility plan for your orchard. The following tables are designed only to help you translate general recommendations into amounts for example common products.

Major Nutrient Managements

Boron deficiency

Apply deficiency rates only if boron deficiency appears during growing season. Small annual foliar application is recommended. Optimal timing is during bloom for most tree fruit, and any time of year is appropriate for apples. Keep adequate levels in the soil for root growth. Excess of boron can lead to severe toxicity and application rate should be carefully calculated. Fertigation can also lead to uneven distribution and toxicity (around leaks/junctions) and is not recommended. The commercial guideline for soil application of B in Washington is a surface-broadcast application of 3 lb actual B per acre, made once every three years. The suggested foliar spray rate is 1.0 lb B/acre for B-deficient orchards. Soil application is suggested if the soil test level is below 0.5 mg/kg or if B deficiency symptoms are present (Peryea, 2004).

Boron maintenance

Prepink to pink or postharvest timing is preferred. Apply amount equivalent to 0.5 pound actual B per acre.

Calcium (bitterpit of apples)

Calcium (bitterpit of apples): 2-4lb/A per application. Make 6 to 12 applications from early June to Late August. 5 to 15 lbs of actual Ca per season is recommended which equals 15 to 50 pounds of calcium chloride per acre per season. Calcium in the form of calcium chloride is recommended because of its proven effectiveness and lower cost. See Penn State Extension's useful calculator for comparing calcium chloride to other sources of calcium, as it is important to make sure you develop a season-long program for applying sufficient total amounts of elemental calcium. Rate Recommendations Actual Ca lb/A per season Actual Ca lb/A Expected Results 4-5 This is the lowest

rate that should be used. It will give some control of bitter pit and corking, will cause no leaf burning and is not likely to enhance storage. 6-8 Should give good control of preharvest physiological disorders. It should not cause any significant leaf injury and will probably not enhance fruit storage life. 9-11 Should give excellent control of corking and bitter pitting and should be the intermediate rate. It may enhance fruit storage life and should result in almost no leaf injury. 12-14 The highest rate that should be used. Should give outstanding control of corking and bitter pit. May result in some enhanced storage life. Courtesy Dr. Rob Crassweller, Penn State Extension.

Calcium (cherry fruit firmness and reduced cracking)

Six weekly sprays of $\text{Ca}(\text{NO}_3)_2$ or chelated Ca sources (Ca^{2+} at 0.1-0.15%) between pit hardening and harvest has been shown to increase calcium quantity in fruit and post harvest quality (Wang, 2016). Greater than 0.2% Ca^{2+} increases risk of leaf burning and reducing fruit size. Fruit applications do not replace, but only augment, good management of soil Ca, irrigation and root health.

Magnesium deficiency

Apply in June. Repeat in July if necessary. Do not apply after August 1. Follow manufacturer's label for labeled product rates.

Nitrogen deficiency

Apply only as needed to apples or cherries. Not effective on pear or other stone fruits and can cause injury.

Zinc deficiency

Annual foliar applications are recommended in calcareous or high pH soils. Preferred timing is late dormant (stone fruit), silver-tip (apples and pears), and post-harvest (all tree fruits except for apricot). Zinc sprays should be avoided during the growing season unless deficiency symptoms occur. Zinc sulfates are common but can cause tissue damage when temperatures are greater than 85 °F after the application. Zinc sulfate is also not compatible with dormant oil or lime sulfur. Zinc chelates are also available and are less likely to cause russet. If little leaf and/or rosette are present, use deficiency rates. The deficiency rates for Zn sulfate or Zn oxysulfate are 14 pounds actual Zn per acre (dormant timing sprays) and 9 pounds actual Zn per acre (postharvest). Use the label rate if applying Zn chelates late dormant or postharvest; however, the label rate often will not supply enough Zn for Washington orchard needs. If sprays are applied during the growing season, use only 2 to 4 lb actual Zn as Zn sulfate or Zn oxysulfate per acre (non-bearing trees only) or the label rate of an appropriate Zn chelate (bearing or non-bearing trees). Because Zn deficiency is so widespread in Washington orchards, WSU recommends that Zn be applied every year in the form of Zn maintenance sprays even if little leaf or rosette are absent. The maintenance rates for Zn sulfate or Zn oxysulfate are 2 to 4 lb actual Zn per acre for both late dormant and postharvest sprays. Use the label rate if Zn chelates are applied. There is little justification for applying a maintenance Zn spray during the growing season (Peryea, 1995).

Dormant/Delayed Dormant

Nutrient Management	Chemical	Rate per Acre	Notes
Zinc deficiency	zinc chelate or organic complex	See Label	
	zinc sulfate, dry, 36% Zn	40 lb	Dormant spray only. Dissolve in hot water before adding to spray tank.
	basic zinc sulfate, liquid, 20-25% Zn	See Label	
	zinc sulfate, liquid, 10-12% zinc	12 gal	
Zinc deficiency, non-bearing trees	basic zinc sulfate, dry, 50-52% Zn	6-12 lb	Dormant spray only. Dissolve in hot water before adding to spray tank. Oil free sprays are more effective.
Zinc maintenance	basic zinc sulfate, dry, 50-52% Zn	6-12 lb	Dormant spray only. Dissolve in hot water before adding to spray tank. Oil free sprays are more effective.
	zinc sulfate, dry, 36% Zn	6 gal	
	zinc sulfate, liquid, 10-12% zinc	2-4 gal	
	zinc chelate or organic complex	See Label	
	basic zinc sulfate, liquid, 20-25% Zn	See Label	

Prepink/Pink

Nutrient Management	Chemical	Rate per Acre	Notes
Boron deficiency	boric acid, dry, 17% B	6 lb	
	boric acid liquid, 10% B	1 gal	
	sodium borate, dry, 16.5-20.5% B	5-6 lb	
Boron maintenance	boric acid liquid, 10% B	2 qt	
	boric acid, dry, 17% B	3 lb	
	sodium borate, dry, 16.5-20.5% B	2.5-3 lb	

bloom

Nutrient Management	Chemical	Rate per Acre	Notes
Nitrogen and sulfur maintenance	ammonium thiosulfate, liquid, 12%N, 25%S	See Label	

Postbloom

Nutrient Management	Chemical	Rate per Acre	Notes
Boron deficiency	sodium borate, dry, 16.5-20.5% B	5-6 lb	Apply only if boron deficiency appears during growing season. Apply amount equivalent to 1.0 pound actual B per acre.
	boric acid liquid, 10% B	1 gal	
	boric acid, dry, 17% B	6 lb	
Boron maintenance	sodium borate, dry, 16.5-20.5% B	2.5-3 lb	Prepink to pink or postharvest timing is preferred. Apply amount equivalent to 0.5 pound actual B per acre.
	boric acid liquid, 10% B	2 qt	
	boric acid, dry, 17% B	3 lb	
Calcium (bitterpit of apples)	calcium chloride, dry, 34-36% Ca	2-4 lb	
Calcium (cherry fruit firmness and reduced cracking)	calcium nitrate fertilizer grade		
Calcium (pear alfalfa greening, Anjou cork spot) Calcium (pear alfalfa greening, Anjou cork spot)	calcium chloride, dry, 34-36% Ca	4 lb	Apply four applications from early June to August. Dilute sprays are most effective. Can cause fruit injury.
Copper Deficiency	copper chelate or organic complex		Follow manufacturer's label. May be incompatible with calcium chloride. Can cause fruit injury.
	basic copper sulfate, liquid		
Iron (lime induced chlorosis)	iron chelate or organic complex	See Label	
Magnesium deficiency	magnesium sulfate		Apply in June. Repeat in July if necessary. Do not apply after August 1. Follow manufacturer's label for labeled product rates.
	magnesium chelate or organic complex		Apply in June. Repeat in July if necessary. Do not apply after August 1. Follow manufacturer's label for labeled product rates.

Nutrient Management	Chemical	Rate per Acre	Notes
	magnesium nitrate 0.4LC	6-12 gal	
	magnesium nitrate, dry, 13.5% Mg	20-40 lb	
Nitrogen deficiency	urea	2-10 lb	Apply only as needed to apples or cherries. Not effective on pear or other stone fruits and can cause injury.
Zinc deficiency, bearing trees	zinc chelate or organic complex		Follow manufacturer's label.
Zinc deficiency, non-bearing trees	basic zinc sulfate, dry, 50-52% Zn	6-12 lb	Dormant spray only. Dissolve in hot water before adding to spray tank. Oil free sprays are more effective.
	basic zinc sulfate, liquid, 20-25% Zn	See Label	
	zinc chelate or organic complex	See Label	
	zinc sulfate, liquid, 10-12% zinc	2-4 gal	Can cause injury, particularly on stone fruits. Follow manufacturer's label for labeled products.
	zinc sulfate, dry, 36% Zn	6-12 lb	Can cause injury, particularly on stone fruits. Follow manufacturer's label for labeled products.
Zinc maintenance	zinc sulfate, dry, 36% Zn	6 gal	

See General Recommendations for guidelines on table use. Read all product labels carefully.

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